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FLOOD AS ONE OF THE MANIFESTATIONS OF HARMFUL EFFECTS OF WATER ON THE EXAMPLE OF FOUR UNITED TERRITORIAL COMMUNITIES OF ODESSA REGION

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Abstract. Flooding is one of the manifestations of the harmful effects of water, which is strongly manifested around the world. Its manifestations are recorded in Ukraine, mainly in the western regions. In the central, eastern and southern regions, periodic flooding is observed in the basins of large rivers (Danube, Dniester, Dnieper, etc.). With the beginning of the XXI century local periodic flooding is increasingly recorded in other areas. And if in the western regions we know almost everything about the causes and risks of flooding, in other areas there is almost no research and knowledge. Recognizing the significant economic and social damage from flooding at the state level, the Ministry of the Interior issued an order approving the "Preliminary Flood Risk Assessment Methodology" designed to carry out a preliminary flood risk assessment to identify areas with potentially significant flood risks in all areas river basins of Ukraine, and other possible sources of flooding, to minimize the negative consequences associated with flooding, which have an impact on human health, environment, economy, cultural heritage, etc. To do this, it was necessary to create a risk passport within each settlement (SM), but in most of them they are missing.

The aim of the work is to show an effective approach to solve the problem of preventing such a negative phenomenon as flooding in the southern regions on the example of four associations of territorial communities (TC) of Belgorod-Dniester district (formerly Tatarbunary). The subject of the study were the factors of formation of this negative phenomenon within 34 SM.

To solve this problem, an approach (algorithm), which consists of three main stages and the application of GIS programs Arc Map method 3D analysis, is proposed. At the same time, one of the main elements of the study was the existing hydraulic structures (HS). Based on the results of work within each state of emergency, the types, location, quantity and technical condition of the HS were determined. Maps of availability and technical condition of the HS, places of possible flooding with the direction of the main water flows are compiled in electronic form.

The approach mentioned in this paper allows to minimize, and in some places to remove in the future such a negative phenomenon as flooding within a single state of emergency.

Keywords: harmful effects of water, flooding, settlement, hydraulic structures, protection.

Introduction. Harmful effects of water are important environmental, socio-economic problems, which includes three main areas: flooding, inundation, pollution of surface and groundwater sources.

Flooding, as a phenomenon, can be observed in almost all geographical areas of Ukraine, and is determined by raising the groundwater level (GW) to critical levels, which are determined by a set of criteria. In the territory of Odesa region flooded territories are considered lands with depths of up to 2.0 m, potentially flooded – from 2.0 to 3.0 [1]. Pollution of surface and groundwater sources is closely linked to flooding and inundation, and is also widespread.

Manifestations of flooding, until recently, were considered to be characteristic of mountainous areas and areas adjacent to large rivers. In Ukraine, this phenomenon is more pronounced in the western regions, but in recent decades is increasingly recorded in the southern regions, including and in the Odessa region.

In general, flooding is caused by floods, which occur when water goes beyond its normal shores and floods large areas of land [2]. Usually the result is a significant increase in water level. The reason: on rivers – due to increased water inflow due to rain, melting snow, etc.; on lakes or reservoirs – due to the excess of water inflow over outflow. Sometimes the reason for theflooding can be the wind, which "catches up" with the water; difficulty of leakage due to technical malfunctions in artificial reservoirs or the formation of natural dams, which sometimes occur on mountain rivers due to landslides (usually after earthquakes); breakthrough of water on the plain, the level of which is below the water level. Such floods usually occur due to the break of dams or changes in the riverbed.

According to Article 1071 of the Water Code of Ukraine, paragraph 7 of the "Action Plan for the Implementation of the Concept of Risk Management of Man-Made and Natural Emergencies for 2015-2020", approved by the Cabinet of Ministers of Ukraine №419-r, dated March 25, 2015, implementation of the provisions of Directive 207/60/EC of the European Parliament and of the Council of 23 October 2007 on flood risk assessment and management, the Ministry of the Interior issued an order "On approval of the Preliminary Flood Risk Assessment Methodology" in order to carry out a preliminary flood risk assessment, which will identify potentially significant flood risks in all areas of Ukraine's river basins and other possible sources of flooding, to minimize the negative consequences associated with flooding that affect human health, environment, economy, cultural heritage, etc. [3].

During the preliminary flood risk assessment in 2018, floods caused by river waters were considered. A total of 3.222 rivers flow within Ukraine, each of which is a potential source of flooding emergencies. However, the hydrological study of these rivers is not very perfect, as evidenced by the small number of hydrological posts. Of the above number of rivers, hydrological posts are located on only 217 of them, which is not even 10%. The worst studied area is the Black Sea river basin, where only three hydrological posts on three of the 67 rivers are located [4].

According to the above, local (settlement, city, district, regional) Passports of risk of emergencies and programs for their implementation were to be adopted. But in fact the program was adopted only at the regional level. In the direction of protection of rural NP and agricultural lands from harmful effects of water in the programs of Odessa region provided:

– construction, reconstruction and overhaul of six hydraulic structures, four protective flood dams;

– construction and reconstruction of four shore protection structures;

– clearing and settlement of riverbeds and reservoirs, restoration of favorable hydrological regime and sanitary condition of rivers by 21.8 km;

– reduction of surface runoff intensity, afforestation and flooding of 434 ha of coastal protection strips;

– conducting research and design and survey work;

– creation and reconstruction of production bases for the operation of flood protection facilities;

– acquisition of technical means for the operation of flood protection facilities [5, 6].

According to "Passport …" in the Odessa region in the risk zone of flooding within the study areas fall with. Nerushay, Bashtanivka, Strumok and the city of Tatarbunary due to the nearby Nerushay, Dmytrivsky and Kagach reservoirs [7]. This did not take into account flooding, which has been on the test sites since 2000.

Analysis of recent research and publications. The analysis of the existing materials testifies to the practical absence of scientific publications of specialists on flooding of the state of emergency in the southern part of Ukraine. Most studies and articles cover the state of this phenomenon in the western regions [8, 9, etc.]. Basic information about the phenomenon that occurred can be obtained only from periodic sources [10, 11].

The aim of the work is to show an effective approach to solve the problem of preventing such a negative phenomenon as flooding in the southern regions on the example of four united territorial communities (UTC) of Belgorod-Dniester district (formerly Tatarbunary). Identify possible causes of flooding and prospects for their elimination to minimize the negative consequences. The subject of the study were various HS in each locality.

Materials and methods of research. Analysis of materials and field studies were conducted within 33 SM four UTC in the period 2020-2021. At the same time, the existing materials for the 30-year period were processed - mostly newspaper articles and eyewitness accounts.

The following research *methods* were used during the works:

– *empirical method* – field and in-house work (detection of existing HS, visual assessment of their technical condition, capacity measurements, clogging of the watercourse before and after the HS, photography, analysis of the data);

– *methods of theoretical research* – formalization of the obtained data in the form of construction of various maps and maps and verification of some assumptions using field materials;

– *universal research methods* – analysis of the obtained systematized data using GIS programs Arc Map, interpolation method 3D analysis [12, 13].

The main problem in studying the state of flooding of the state of emergency is the lack of any observations and knowledge about the number of HS in each state of emergency. The "Methodology of preliminary flood risk assessment" with variations of the author was taken as a basis [14].

The work was performed in several stages.

At the first stage, in-house training was conducted, which consisted of studying the existing literary materials and Internet resources in the area of work. Data on the state of emergency of the district: number of UTC, state of emergency, area of state of emergency, number of buildings and yards, sources of water supply, availability of water supply and sewerage network, data taken from previous work on flooding and partially covered in [15-17]; preparation of cartographic material 1: 10000 scale: copying from master plans, tracing, making copies; development and preparation of plans for field work: preparation of "draft" maps, definition and compilation of symbols, definition of routes. In addition, the analysis of weather and climatic conditions was carried out, namely the amount of precipitation and their intensity.

The second stage – field work, which was performed on certain routes. At the same time, all available HS were recorded in each state of emergency – bridges, pipe crossings, storm drains, sluices, etc.; places of possible ingress of rain and melt water (beams, depressions); the presence of storm drains. At the location of the HS measurements of the capacity of the structure were carried out – width and height were measured; the description of a structure and appearance was carried out; the object was photographed; locations were plotted on the map. The results of the observation were recorded in a field diary. During the survey, additional sources of water (lakes, reservoirs, ponds, water supply, sewerage, etc.) and pollutants (landfills, burial grounds, chemical warehouses, farms, etc.) were identified.

At the third stage, in-house processing of materials obtained as a result of the second stage (field) was carried out, namely the analysis of the obtained data and their systematization using GIS programs Arc Map, interpolation method 3D analysis. At this stage, on the prepared cartographic basis within each state of emergency, places of possible flooding were applied, taking into account the provisions [14]. The assessment of the state of the HS was carried out on the following indicators: the state of "good" (the building is not clogged, the channel before and after the HS is relatively clean); condition "satisfactory" (the building is partially clogged, the channel before and after the HS is partially clogged); condition "unsatisfactory" (the building is clogged, the channel before and after the HS is clogged). Data on rainfall were compared with known floods in the study area.

Research results. Within this area of work, local and major floods may occur in 11 SM, namely in the villages of Bashtanivka, Borysivka, Hlyboke, Delzhiler, Division, Zhovtiy Yar, Zarichne, Kochkuvate, Novooleksiyivka, Nerushai and Strumok, as well as the city of Tatarbunary. The total area of possible flooding may be more than 845 hectares. To obtain the above information, the availability, quantity and technical condition of the HS in each state of emergency were analyzed; distribution of the amount and intensity of precipitation, the possibility of additional water supply. For

each state of emergency in electronic form maps of the place of possible flooding are constructed; location and technical condition of the HS (Fig. 1). For the city of Tatarbunary, a separate photo catalog and a map of the availability and technical condition of the HS.

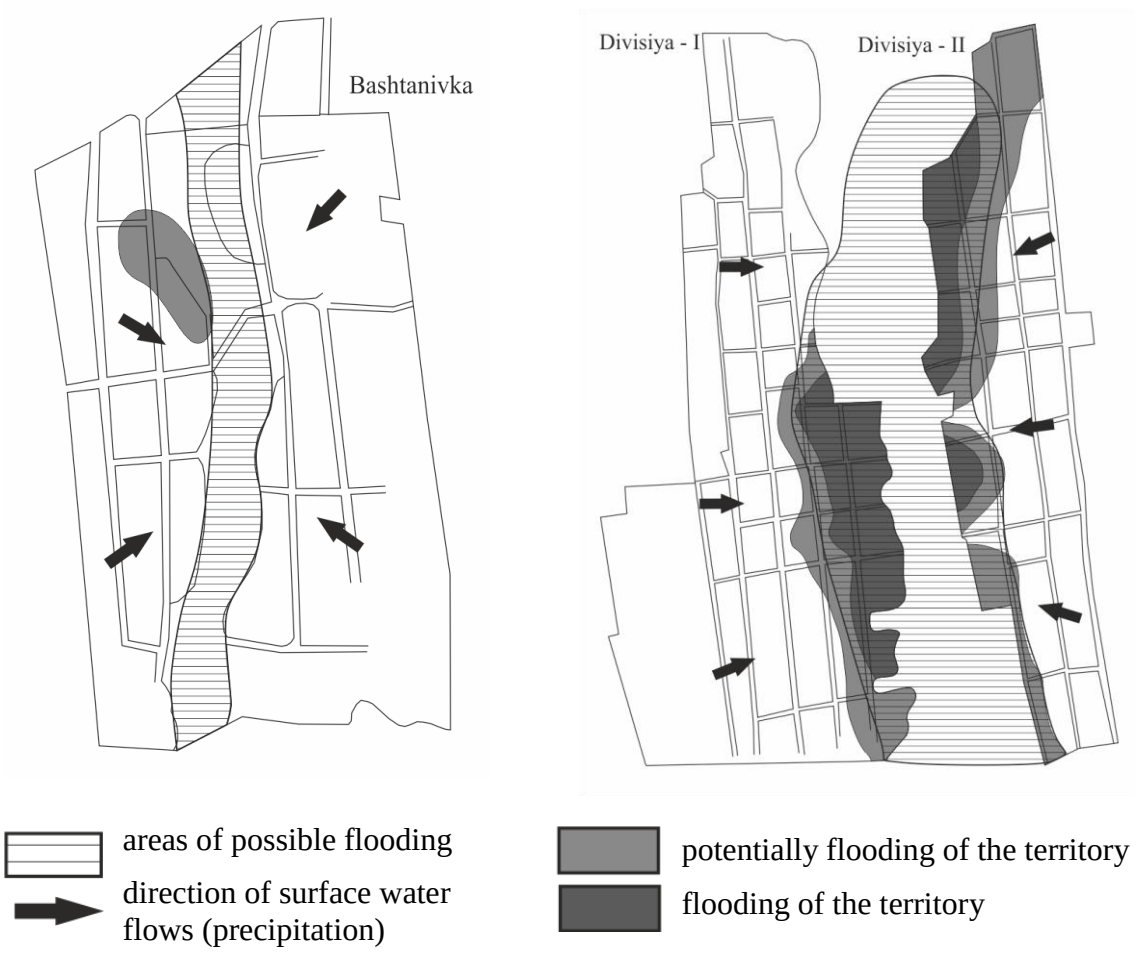


Fig. 1. Map of the manifestation of the harmful effects of water within the village Bashtanivka and the village Divisiya

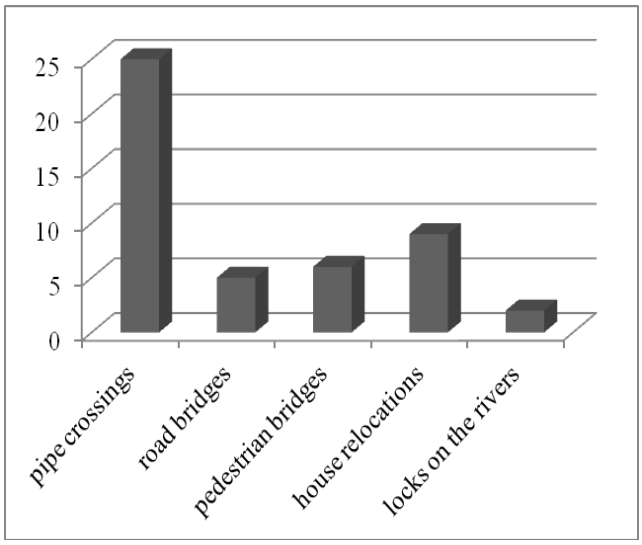
The main findings on the coverage of flooding will be considered in detail in the example of Tatarbunary.

In total, there are 47 main HS within the city (Fig. 2). Most of them are pipe (25) and adjacent crossings (9); 6 pedestrian and 5 road bridges; two gateways.

At the same time, there are 13 HS in "good" and "satisfactory" condition, and 21 in "unsatisfactory" condition. The vast majority of unsatisfactory condition of HS is related to pipe crossings (17 units) (Fig. 3).

Unsatisfactory condition is caused mainly by clogging of riverbeds or drains and storm drains with vegetation (mostly reeds) with various debris, which make it impossible for water to pass sufficiently, causing it to overflow. Non-catastrophic flooding within the city is caused by the absence or clogging of existing storm drains, poor planning of buildings and engineering structures. Such a negative example is the market area, where even with a small amount of precipitation flooded the area. Flooding of drained lands is caused mainly by the deterioration of the system, clogging of drainage canals and unsatisfactory condition of the HS.

The following indicators were noted in the photo catalog: type of HS; its serial number and reference to the street and the house; technical parameters: width, length, diameter; visual assessment of capacity; the state of the channel before and after the HS.



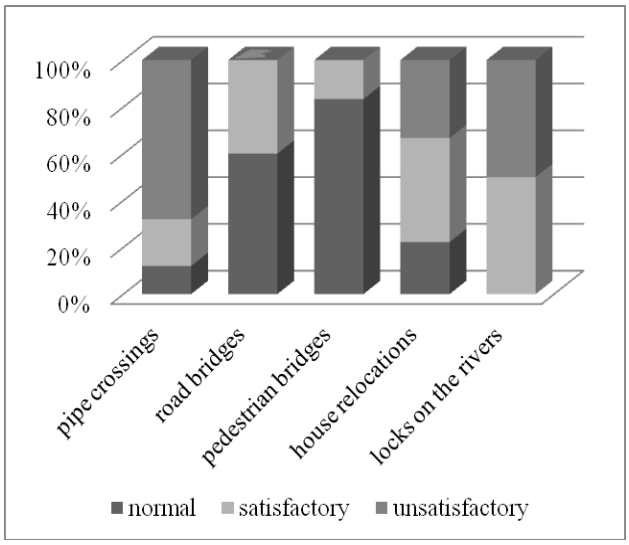


Fig. 2. Available number of HS in Tatarbunary Fig. 3. Technical condition of HS in Tatarbunary

Conclusions. Flooding, as a factor, takes place in the research area of Belgorod-Dniester district of Odessa region. Its manifestations and intensity depend on many factors, but the main ones are the technical condition of hydraulic structures (bridges, crossings), drainage (where it is) and the water supply network in combination with weather and climatic conditions. Within the area of work with 33 SM and the city of Tatarbunary in just over 32% may be signs of flooding. At the same time, flooding of territories within the state of emergency and adjacent territories can be caused by two main factors: external and internal. The most catastrophic floods (Tatarbunary and Novooleksiyivka, Bilolissia – 2013, Division – 2020) over the past twenty years caused by the arrival of a significant amount of water from outside, namely from neighboring areas: the break of the reservoir dam near the village. Tarutine, the break of the dam of the reservoir in Moldova near the Ukrainian village of Minaylivka, the arrival of water on the river Hadzhider. It is these settlements and lands are located in the estuaries of the rivers Kogilnik, Sarata and Hajider.

Internal factors that provoke and cause flooding are primarily related to the technical condition of the HS (bridges, pipe crossings, sluices, existing storm drains), the condition of existing natural drains (beams, depressions, small ravines, etc.), small rivers and their valleys. Their clogging or faulty condition, even with light rainfall, can lead to flooding. An example of this is the flooding of the central part of the city and places adjacent to the Kagach-Fontanka riverbed in 2001, when more than 50 mm of rain fell in a few hours, and clogged HS caused water to flow out of the riverbed [10, 11]. A separate item should highlight the technical condition of the dams of the Kagach, Dmitrov and Nerushay reservoirs and monitoring the dynamics of volumes in these reservoirs. According to "Passport …" in the Odessa region in the risk zone of flooding fall with. Nerushay, Bashtanivka, Strumok and the city of Tatarbunary due to the nearby Nerushay, Dmytrivsky and Kagach reservoirs [7].

To minimize the manifestations of flooding it is necessary:

– to develop for each state of emergency "Passport of risk of emergencies" and a program for their implementation;

– for this purpose it is necessary to carry out inventory of existence and a condition of hydraulic engineering constructions within each state of emergency, possibilities of access system, to carry out the analysis of scales of previous floods;

– identify the main priority areas of activity and those responsible for maintaining the existing GTS in good condition;

– to obtain from the owners of reservoirs detailed exploration work on the condition of dams with the determination of physical and technical indicators of these structures;

– if necessary, involve specialists in solving these problems by engineering methods.

In this paper, the approach using GIS programs Arc Map, a method of interpolation 3D analysis, allows you to assess the state and prospects of flooding in a particular state of emergency, a particular territorial community (PTC), district and region as a whole. The availability and technical condition of hydraulic structures, the direction and place of possible flooding, etc. can be made on the ready cartographic basis. Such information about the state of emergency makes it possible not only to identify areas with manifestations of harmful effects of water, but also to identify places and priority areas where it is possible to prevent the manifestations of such a negative phenomenon. It is much better to prevent than to overcome the consequences, which are not only purely economic but also social.

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ЗАТОПЛЕННЯ ЯК ОДИН ІЗ ПРОЯВІВ ШКІДЛИВОЇ ДІЇ ВОД НА ПРИКЛАДІ ЧОТИРЬОХ ОБ`ЄДНАНИХ ТЕРИТОРІАЛЬНИХ ГРОМАД ОДЕЩИНИ

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Анотація. Затоплення є одним з проявів шкідливої дії вод, яке потужно проявляється в усьому світі. Його прояви фіксуються і на території України, переважно в західних областях. В центральних, східних і південних областях періодичні затоплення спостерігаються в басейнах великих річок (Дунай, Дністер, Дніпро та ін.). З початком XXI ст. локальні періодичні затоплення все частіше фіксуються і на інших територіях. І якщо в західних областях про причини і ризики затоплення ми знаємо майже все, то на іншій території дослідження і знання практично відсутні. Розуміючи значну економічну і соціальну шкоду від затоплення на рівні держави, Міністерством внутрішніх справ був виданий наказ про затвердження «Методики попередньої оцінки ризиків затоплення», яка розроблена з метою здійснення попередньої оцінки ризиків затоплення для визначення територій, які мають потенційно значні ризики затоплення у всіх районах річкових басейнів України, та інші можливі джерела затоплення, мінімізувати негативні наслідки, пов'язані із затопленням, які мають вплив на здоров'я людей, довкілля, економіку, культурну спадщину тощо. Для цього в межах кожного населеного пункту (НП) необхідно було створити паспорт ризику, але в більшості з них вони відсутні.

Метою роботи є показ дієвого підходу до вирішення питання щодо попередження такого негативного явища як затоплення в південних регіонах на прикладі чотирьох об'єднаннях територіальних громад (ОТГ) Білгород-Дністровського району (в минулому Татарбунарського). Предметом дослідження були чинники формування цього негативного явища в межах 34 НП.

Для вирішення даної проблеми запропонований підхід (алгоритм), який складається з основних трьох етапів та застосування ГІС програм Arc Map метод 3D аналіз. При цьому одним з головних елементів вивчення слугували наявні гідротехнічні споруди (ГТС). За результатами роботи в межах кожного НП були визначені види, розміщення, кількість і технічний стан ГТС. Складені в електронному вигляді карти наявності і технічного стану ГТС, місця можливого затоплення з направленням основних потоків води.

Зазначений в даній роботі підхід дозволяє мінімізувати, а подекуди зняти на майбутнє таке негативне явище як затоплення у межах окремого НП.

Ключові слова: шкідлива дія вод, затоплення, населений пункт, гідротехнічні споруди, захист.

ЗАТОПЛЕНИЕ КАК ОДНО ИЗ ПРОЯВЛЕНИЙ НЕГАТИВНОГО ДЕЙСТВИЯ ВОД НА ПРИМЕРЕ ЧЕТЫРЕХ ОБЪЕДИНЕНЫХ ТЕРИТОРИАЛЬНЫХ ОБЩЕСТВ ОДЕЩИНЫ

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Аннотация. Затопление является одним из проявлений негативного действия вод, которое сильно проявляется во всем мире. Его проявления фиксируются и на территории Украины, преимущественно в западных областях. В центральных, восточных и южных областях периодические затопления наблюдаются в бассейнах крупных рек (Дунай, Днестр, Днепр и др.). С началом XXI века локальные периодические затопления все чаще фиксируются и на других территориях. И если в западных областях о причинах и рисках затопления мы знаем почти все, то на остальной территории исследования и данные практически отсутствуют. Понимая значительный экономический и социальный ущерб от затопления на уровне государства, Министерством внутренних дел был издан приказ об утверждении «Методики предварительной оценки рисков затопления», разработанный с целью осуществления предварительной оценки рисков затопления для определения территорий, имеющих потенциально значительные риски затопления во всех районах речных бассейнов Украины и другие возможные источники затопления, минимизировать негативные последствия, связанные с затоплением, которые оказывают влияние на здоровье людей, окружающую среду, экономику, культурное наследие и т.д. Для этого в пределах каждого населенного пункта (НП) необходимо было создать паспорт риска, но практически в каждом из НП они отсутствуют.

Целью работы является показ действенного подхода к решению вопроса предупреждения затопления в южных регионах на примере четырех объединённых территориальных общин (ОТО) Белгород-Днестровского района (в прошлом Татарбунарского). Предметом исследования являлись факторы формирования затопления в пределах 34 НП.

Для решения данной проблемы предложен подход (алгоритм), состоящий из трех основных этапов и применения ГИС программ Arc Map метод 3D анализ. При этом одним из главных элементов изучения служили гидротехнические сооружения (ГТС). По результатам работы в пределах каждого НП были определены виды, размещение, количество и техническое состояние ГТС. Составлены в электронном виде карты наличия и технического состояния ГТС, места возможного затопления с направлением основных потоков воды.

Указанный в данной работе подход позволяет минимизировать, а в некоторых случаях в будущем снять такое негативное явление как затопление в пределах отдельного НП.

Ключевые слова: негативное действие вод, наводнение, населенный пункт, гидротехнические сооружения, защита.

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